UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/757,586	01/15/2004	Robert D. Edwards	EI-2-04-001	4656

7590 11/15/2005

Lawrence R. Fraley, IP Law Counsel
Endicott Interconnect Technologies, Inc.
FBU/257-2 AA12
1701 North Street
Endicott, NY 13760

EXAMINER	
VAN, LUAN V	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 11/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/757,586	EDWARDS, ROBERT D.	
	Examiner	Art Unit	
	Luan V. Van	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) *16-18* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *1/15/04*.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

GB

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-15, drawn to a method, classified in class 205, subclass 125.

II. Claims 16-18, drawn to a product, classified in class 257, subclass 449.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another and materially different process such as sputter deposition or chemical vapor deposition.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, and the search required for Group I is not required for Group II, restriction for examination purposes as indicated is proper, restriction for examination purposes as indicated is proper.

During a telephone conversation with the Applicant's representative, Mr. Lawrence Fraley, on 11/3/05 a provisional election was made with traverse to prosecute

the invention of Group I, claims 1-15. Affirmation of this election must be made by applicant in replying to this Office action. Invention of Group II is withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 5-8, and 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Hey et al.

Regarding claim 1, Hey et al. teach a method of electrolytically plating a layer of metal on the internal surface of an opening within a substrate, said method comprising: substantially immersing a substrate having an opening therein within an electroplating

bath containing ions of a metal to be deposited onto the internal surface of said opening (Example); and passing an electric current through said bath wherein said current includes modulated forward and reverse pulses, selected ones of said forward and/or reverse pulses followed by a pause (off-time, see paragraph 14-26) in said electric current, so as to deposit a substantially uniform layer of said metal on said internal surface of said opening.

As well known in the art of of electroplating or electrolytic plating, any electroplating process inherently comprises the steps of immersing a substrate in an electroplating bath containing ions of a metal to be deposited and passing an electric current through said bath. Ions of the metal to be electroplated are inherently present in an electroplating solution, since the positive metal ions are attracted to the cathode where they combine with electrons, yielding neutral metal which is plated onto the electrode.

Regarding claim 5, Hey et al. teach an electroplating method wherein the forward pulses each have a pulse width within the range of from about 5 to about 50 milliseconds (claim 8), which is within the range of the instant claim.

Regarding claim 6, Hey et al. teach an electroplating method wherein the reverse pulses each have a pulse width within the range of from about 1 to about 500 milliseconds (claim 7), which is within the range of the instant claim.

Regarding claim 7, Hey et al. teach an electroplating method wherein the pause (or off - time) in said electric current following said selected ones of said forward and/or reverse pulses is within the range of from about 1 to about 500 millisecond (claim 3), which is within the range of the instant claim.

Regarding claim 8, Hey et al. teach an electroplating method wherein the the ratio of times of said forward pulse to said reverse pulse to said pause is within the range of from about 40:4:1 to about 400:20:1. The time duration of the forward pulse, reverse pulse, and off - time as taught by Hey et al. can be selected within their respective range to yield the ratio within the range of the instant claim, such as 40, 4, and 1 millisecond, respectively.

Regarding claim 11, Hey et al. teach an electroplating method wherein the electroplating bath further includes organic brighteners and carriers, also known as suppressors, (paragraph 29).

Claims 1-6 and 9-11 are rejected under 35 U.S.C. 102(e) as being anticipated by Tsuchida et al.

Regarding claim 1, Tsuchida et al. teach a method of electrolytically plating a layer of metal on the internal surface of an opening within a substrate, said method

comprising: substantially immersing a substrate having an opening therein within an electroplating bath containing ions of a metal to be deposited onto the internal surface of said opening (Example 1-3); and passing an electric current through said bath (Example 1-3) wherein said current includes modulated forward and reverse pulses, selected ones of said forward and/or reverse pulses followed by a pause (rest time, see paragraph 67) in said electric current, so as to deposit a substantially uniform layer of said metal on said internal surface of said opening. Tsuchida et al. teach that the rest time is between forward electrolysis and reverse electrolysis. This reads on the instant claim because the rest time follows the forward pulse.

As well known in the art of of electroplating or electrolytic plating, any electroplating process inherently comprises the steps of immersing a substrate in an electroplating bath containing ions of a metal to be deposited and passing an electric current through said bath. Ions of the metal to be electroplated are inherently present in an electroplating solution, since the positive metal ions are attracted to the cathode where they combine with electrons, yielding neutral metal which is plated onto the electrode.

Regarding claims 2 and 3, Tsuchida et al. teach an electroplating method wherein the substrate can be a printed circuit board or wafer having through holes and/or via-holes (paragraph 78); and the resin/dielectric substrate is a fiberglass-reinforced epoxy resin (paragraph 79).

Regarding claim 4, Tsuchida et al. teach an electroplating method wherein the metal is copper.

Regarding claim 5, Tsuchida et al. teach an electroplating method wherein the forward pulses each have a pulse width within the range of from about 1 to about 50 milliseconds (paragraph 67), which is within the range of the instant claim.

Regarding claim 6, Tsuchida et al. teach an electroplating method wherein the reverse pulses each have a pulse width within the range of from about 0.2 to about 5 milliseconds (paragraph 67), which is within the range of the instant claim.

Regarding claim 9, Tsuchida et al. teach an electroplating method wherein the each of the pairs of said forward and reverse pulses are provided for an average current density of from about 0.1-200 A/dm2 (or about 1-200 Amperes per square foot) (paragraph 68), which is within the range of the instant claim.

Regarding claim 10, Tsuchida et al. teach an electroplating method wherein the ratio of said current densities of said forward pulses to said reverse pulses is within the range of from about 1 to 1-10 (paragraph 68), which is within the range of the instant claim.

Regarding claim 11, Tsuchida et al. teach an electroplating method wherein the electroplating bath further includes organic brighteners and carriers, also known as surface active agents, (paragraph 47 and 75).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 2-4 and 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hey et al. in view of Tsuchida et al.

Hey et al. teach the method as described above in addressing claim(s) 1.

The difference between the reference to Hey et al. and the instant claims is that the reference does not explicitly teach plating on a dielectric substrate (claims 2-3) nor the specific forward and reverse current densities (claims 9-10).

Regarding claims 2 and 3, Tsuchida et al. teach an electroplating method wherein the substrate can be a printed circuit board or wafer having through holes and/or via-holes (paragraph 78); and the resin/dielectric substrate is a fiberglass-reinforced epoxy resin (paragraph 79).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Hey et al. by plating on the dielectric substrate having through holes as taught by Tsuchida et al., because it is conventionally known to plate copper on a dielectric substrate, such as a printed circuit board, having through holes. It would have been obvious to one having ordinary skill in the art to use a fiberglass-reinforced epoxy resin, because a skilled artistan would be able to select from among known suitable resins for printed circuit board.

Regarding claim 9, Tsuchida et al. teach an electroplating method wherein the each of the pairs of said forward and reverse pulses are provided for an average current density of from about 0.1-200 A/dm2 (or about 1-200 Amperes per square foot) (paragraph 68), which is within the range of the instant claim.

Regarding claim 10, Tsuchida et al. teach an electroplating method wherein the ratio of said current densities of said forward pulses to said reverse pulses is within the range of from about 1 to 1-10 (paragraph 68), which is within the range of the instant claim.

Addressing claims 9-10, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Hey et al. by using the range of current densities of Tsuchida et al., because such range of current densities would prevent clumps from forming and marring the appearrance of plating (paragraph 56), and because it would form a fine deposited film with satisfactory appearance and via - filling property (paragraph 10).

Regarding claim 4, Hey et al. teach an electroplating method wherein the metal is copper.

Claims 12 and 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hey et al. in view of Barnards et al.

Hey et al. teach the method as described above in addressing claim(s) 1.

The difference between the reference to Hey et al. and the instant claims is that the reference does not explicitly teach the specific concentration of copper (claim 12) nor the aspect ratio of the substrate (claim 15).

Barnards et al. teach an acid copper plating solution used for plating through-holes in printed circuit manufacture with the through hole has an aspect ratio greater than 10 to 1 (column 8 lines 4-9), wherein the copper plating solution has a copper concentration of 5-25 g/L (column 5 lines 7-10).

Addressing claim 12, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Hey et al. by using the copper concentration of Barnards et al., because such copper concentration would increase the throwing power of the solution without sacrificing leveling or the ability of the deposit to resist thermal stress (column 1 lines 18-22).

Addressing claim 15, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Hey et al. by plating on a substrate having the aspect ratio of Barnards et al., because it is within the ability to one having ordinary skill in the art to electroplate a substrate having high aspect ratio features, and because plating on a substrate having high aspect ratio features is commonly known in the art.

Regarding claim 14, Hey et al. teach an electroplating method wherein the acid is sulfuric acid.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hey et al. in view of Barnards et al., and further in view of Sonnenberg et al.

Hey et al. and Barnards et al. teach the method as described above in addressing claim(s) 12.

The difference between the references and the instant claim is that the references do not explicitly teach the specific concentration of sulfuric acid.

Sonnenberg et al. teach an acid copper plating solution used for plating through-holes in printed circuit manufacture wherein the copper plating solution has an acid concentration of 100-300 g/L (table 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Hey et al. by using the acid concentration of Sonnenberg et al., because such has the concentration would enhance the thickness uniformity of the deposit.

Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchida et al. in view of Hey et al.

Tsuchida et al. teach the method as described above in addressing claim(s) 1.

The difference between the reference to Tsuchida et al. and the instant claims is that the reference does not explicitly teach the specific rest time nor the specific ratio of the forward and reverse current densities to the rest time.

Regarding claim 7, Hey et al. teach an electroplating method wherein the pause (or off - time) in said electric current following said selected ones of said forward and/or reverse pulses is within the range of from about 1 to about 500 millisecond (claim 3), which is within the range of the instant claim.

Regarding claim 8, Hey et al. teach an electroplating method wherein the the ratio of times of said forward pulse to said reverse pulse to said pause is within the range of from about 40:4:1 to about 400:20:1. The time duration of the forward pulse, reverse pulse, and off - time as taught by Hey et al. can be selected within their respective range to yield the ratio within the range of the instant claim, such as 40, 4, and 1 millisecond, respectively.

Addressing claims 7-8, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Tsuchida et al. by using the rest time of Hey et al., because such rest time would be suitable for plating high aspect ratio features to achieve desirable deposition profiles, such as thickness uniformity, and because it would provide a void-free and seem-free deposition of metal in high aspect ratio features.

Claims 12 and 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchida et al. in view of Barnards et al.

Tsuchida et al. teach the method as described above in addressing claim(s) 1.

The difference between the reference to Tsuchida et al. and the instant claims is that the reference does not explicitly teach the specific concentration of copper (claim 12) nor the aspect ratio of the substrate (claim 15).

Barnards et al. teach an acid copper plating solution used for plating through-holes in printed circuit manufacture with the through hole has an aspect ratio greater than 10 to 1 (column 8 lines 4-9), wherein the copper plating solution has a copper concentration of 5-25 g/L (column 5 lines 7-10).

Addressing claim 12, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Tsuchida et al. by using the copper concentration of Barnards et al., because such copper concentration would increase the throwing power of the solution without sacrificing leveling or the ability of the deposit to resist thermal stress (column 1 lines 18-22).

Addressing claim 15, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Tsuchida et al. by plating on a substrate having the aspect ratio of Barnards et al., because it is within the ability to one having ordinary skill in the art to electroplate a substrate having high aspect ratio features, and because plating on a substrate having high aspect ratio features is commonly known in the art.

Regarding claim 14, Tsuchida et al. teach an electroplating method wherein the acid is sulfuric acid.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchida et al. in view of Barnards et al., and further in view of Sonnenberg et al.

Tsuchida et al. and Barnards et al. teach the method as described above in addressing claim(s) 12.

The difference between the references and the instant claims is that the references do not explicitly teach the specific concentration of sulfuric acid.

Sonnenberg et al. teach an acid copper plating solution used for plating through-holes in printed circuit manufacture wherein the copper plating solution has an acid concentration of 100-300 g/L (table 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Tsuchida et al. by using the acid concentration of Sonnenberg et al., because such has the concentration would enhance the thickness uniformity of the deposit.

Conclusion

The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure. Simpson et al., Dahms et al., Lopatin teach similar electroplating method using off time.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV
11/6/05

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700